

DEPARTMENT OF ENERGY/NATIONAL ENERGY TECHNOLOGY LABORATORY–CITY OF PITTSBURGH MEMORANDUM OF UNDERSTANDING “CREATING PITTSBURGH’S ENERGY FUTURE TODAY”



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1.0 Purpose

This report provides a quarterly update of the Department of Energy/National Energy Technology Laboratory's (DOE/NETL) activities, accomplishments, actions, deliverables, and plans in support of a Memorandum of Understanding (MOU) with the City of Pittsburgh (City) to assist the City in the design and implementation of a 21st Century Energy Infrastructure.

2.0 Background



NETL Director Dr. Grace Bochenek and City of Pittsburgh Mayor William Peduto sign MOU on July 17, 2015

The National Energy Technology Laboratory (NETL), on behalf of the United States Department of Energy (DOE), signed an MOU with the City of Pittsburgh on July 17, 2015. The MOU is managed as part of NETL's Strategic Partnerships program in coordination with DOE's Office of Energy Policy and Systems Analysis (EPSA) within the Office of the Secretary. EPSA serves as the office responsible for coordinating participation in the MOU on behalf of other program offices in DOE.

The activities under the MOU are an outgrowth of recent efforts to modernize and secure the U.S. electric power grid from natural disasters, cyber security intrusions, and other threats. For more

than 140 years, the nation's electric grid consisted of large, centralized power generation coupled with long-distance transmission lines and local distribution wires in which power flowed in one direction from generator to consumer. Today, communities like Pittsburgh are looking to move away from this traditional centralized power grid to one more reliant on distributed energy generation. As a result, residential, commercial, and industrial consumers can have a much greater say in how their energy is generated, and through programs like net metering, customers are becoming "prosumers"—both consumers and producers of electricity. Moreover, distributed generation enables the introduction of low-carbon and renewable energy technologies such as microturbines, combined heat and power, fuel cells, and photovoltaics that reduce greenhouse gas emissions, decrease water usage, and create other environmental benefits.

The purpose of this MOU is to allow DOE/NETL and the City of Pittsburgh to work jointly to design and implement a 21st Century Energy Infrastructure that would demonstrate the "City of the Future" with all its attendant environmental, economic, and job-creation benefits. Work under this MOU will serve to position Pittsburgh as a national and global leader in grid modernization and advanced energy technology development and demonstration and application of strategic energy models and planning tools. The outcomes from this MOU will help modernize Pittsburgh's generation and delivery of utility services, develop new business models and markets, grow technology research and development opportunities and product manufacturing, reduce environmental impacts, improve energy operational efficiencies,

enhance resiliency and security through integrated district-based microgrid solutions, address affordability and choices for consumers, and encourage workforce development and training.

The MOU has seven specific goals:

1. Craft strategic plan supporting distributed energy strategies;
2. Identify financial opportunities to catalyze investment in distributed energy systems and supporting activities;
3. Address policy and regulatory needs for distributed energy and infrastructure modernization;
4. Conduct economic analysis of cost/benefits of distributed energy with micro-grid integration and building performance policies;
5. Accelerate growth and access to energy jobs;
6. Form technical team to explore Pittsburgh's efforts; and
7. Prepare technology R&D roadmap for rapid demo and deployment.

The scope of the activities under this MOU will support Pittsburgh's efforts to modernize its energy grid, particularly involving combined heat and power systems and other district-scale energy approaches being undertaken, such as microgrids, and increasing the City's sustainability through expanding the use of locally generated clean (lower carbon), fossil and renewable energy and energy efficiency.

From a grid modernization perspective, DOE/NETL is supporting the City's efforts to create a new energy infrastructure comprised of a network of interconnected, small scale, distributed energy systems or microgrids that will:

- Provide a variety of energy services, including electricity, steam, and/or water (hot and/or chilled);
- Improve resiliency by allowing independent operation ("island mode") or integrated operation with existing energy infrastructure (i.e. the bulk electrical grid);
- Have defined load;
- Allow energy consumers to become "prosumers" – both users and producers of electricity;
- Improve environmental performance and reduce emissions through commercially available, high-efficiency systems;
- Operate off a variety of energy sources to ensure resiliency and fuel diversity (i.e. renewables, low-carbon fossil fuel, and by-products and waste streams); and
- Serve as a test bed for advanced distributed energy technologies on both sides of the electric meter such as microturbines, direct current (DC) power delivery, combined heat and power, solid oxide fuel cells, energy storage devices (e.g., batteries or thermal energy storage), advance power electronics, photovoltaics, and wind turbines.

This effort will establish Pittsburgh as a model city for energy system transformation and as a center of energy innovation. Further, it is intended to build a template for communities seeking to define a modern energy vision in which aging infrastructure and legacy systems are updated with innovative and advanced energy technologies. In doing so, it will deliver resilient, reliable, flexible, secure, sustainable, and affordable energy to consumers.

Under the MOU, DOE/NETL is:

- Helping to coordinate and manage the overall effort;
- Leading efforts to achieve the MOU's seven goals;
- Organizing technical teams and convene partner and stakeholder meetings;
- Providing technical assistance and expertise on a broad array of energy and climate topics;
- Assessing geothermal energy potential of district energy sites;
- Crafting communication and outreach plans and related materials;
- Developing and analyzing baseline energy consumption and GHG emission data; and
- Identifying and supporting potential funding and in-kind technical support opportunities.

Along with DOE/NETL and the City of Pittsburgh, a number of regional and local organizations that crosscut industry, private-sector, academia, and foundations are partnering in the work being performed under the MOU. These include: Carnegie Mellon University, the University of Pittsburgh's Center for Energy, the Urban Redevelopment Authority of Pittsburgh, Duquesne Light, NRG Energy, the University of Pittsburgh Medical Center, Peoples Gas, Oxford Development, Hillman Foundation, RK Mellon Foundation, Heinz Endowment, the Green Building Alliance, the Science Ambassadors, and the RAND Corporation.

3.0 Activities, Actions, and Accomplishments this Quarter

- "Bi-Weekly" MOU tag-up conference calls were held with the MOU implementation/technical team and/or partners on January 2nd, 17th, and 31st, February 28th, and March 14th.
- Tom Feeley and Cliff Blashford of NRG Energy discussed the status of the planned demonstration of an NETL funded 400 kW Solid Oxide Fuel Cell at NRG's North Side district energy facility that is scheduled for 4th quarter of 2017.
- On January 12th NETL met with Angelica Ciranni of the Green Building Alliance at GBA's offices on the South Side. Mr. Feeley provided an overview of the MOU between NETL and the City of Pittsburgh and Mr. Tarka provided a briefing on Pittsburgh energy baseline study. As a result of the meeting GBA was added as a partner to the MOU. In addition, links to the NETL MOU videos were sent to GBA.

- A telecon was held with Chris Shea and Stan Holbrook of the Larimer Consensus Group on January 18th. The purpose of the call was to update Mr. Shea and Mr. Holbrook on an EERE funding opportunity for community-based solar that is focused on low-to-moderate income communities such as Larimer.
- NETL's Technology Development and Integration Center and Research and Innovation Center staff (Mark McCoy, Robert James, and Randy Gemmen) continue to on a case study for potential deep direct use (DDU) of geothermal energy at the Almono site. In the last quarterly report, it was noted that DDU geothermal energy is not currently considered economically viable although that could change under future economic and market conditions where fossil energy alternatives are more expensive, or when well development costs have been reduced. Over the past quarter, NETL has initiated efforts to examine the latter and a draft white paper has been developed that examines technical feasibility of leveraging O&G infrastructure for Geothermal exploration and development in eastern U.S. Approaches reviewed included:
 - Leveraging O&G drilling to explore for and test geothermal targets
 - Dual usage of well pads
 - Dual completion of wells; producing both geothermal resources and O&G from the same wellbore
 - Repurposing depleted wells (horizontal and vertical) to attain geothermal targets
- NETL's support contractor team under the direction of Tom Tarka completed preliminary assessment of the City of Pittsburgh energy (electricity and natural gas) consumption for calendar year 2015. The work is part of NETL's efforts under MOU Goal 7 to develop a technology roadmap. Electricity and natural gas consumption "heat maps" have been created for each zip code within the City of Pittsburgh. The team will be focusing its efforts on refining the preliminary energy baseline assessment and identifying distributed energy technologies that could be applied to proposed network of microgrids to assist the City in reducing its GHG emissions while strengthening energy resiliency. A report entitled *"Pittsburgh 2013 Energy Baseline: Consumption, Trends and Opportunities"* has been distributed to the MOU team for review and comment. The findings from the report were presented at the Pittsburgh Climate Action meeting on February 13th.
- On January 20th NETL spoke with Linda Metropulos of Pittsburgh ACTION Housing on the status of an application to the EERE Sunshot Community Solar announcement. The announcement will provide prize money to low-to-moderate income communities for developing community-based solar projects that have a high potential for replication. ACTION Housing was leading a team comprised of organizations from the City that was considering submitting an application for a community solar project in Homewood.
- NETL spoke with Will Agate and Helena Lilly of NZM Solutions (<http://nzmsolutions.com/>) on January 20th. Net Zero Microgrid Solutions is a Philadelphia-based company that provides a wide variety of leadership and support to

clients interested in deploying smart energy and microgrid solutions as part of improving the economic and social health of their communities. NZM was very much involved in the transition of the Philadelphia Navy Yard into a self-sustaining microgrid and participated in a September 2016 meeting at the Navy Yard to discuss the growth of microgrids and distributed energy in Pennsylvania. The company was interested in how it might help Pittsburgh in its efforts to develop a network of microgrids. Mr. Agate and Ms. Lilly were provided contact information for Grant Ervin of the Mayor's Office.

- Tom Feeley and Grant Ervin of the Mayor's Office spoke on January 26th regarding the respective roles and responsibilities of NETL and the City under the MOU.
- On February 2nd, Tom Tarka and Tom Feeley participated in a call with Barry Kukovitch and Jason Davidek of Peoples Gas to discuss NETL's participation in an April 8th Allegheny League of Municipalities conference at Seven Springs. ALOM expressed interest in a presentation on the MOU and NETL's assessment of the City of Pittsburgh energy consumption and GHG emissions.
- On February 14th, provided Paige Davis of the International District Energy Association a copy of NETL's MOU story *"NETL Partners with the City of Pittsburgh and Regional Stakeholders to Help Design and Implement a 21st Century Energy Infrastructure – Establishing Pittsburgh as a National Model and Global Leader."*
- NETL participated in webinar entitled *"Finding Pennsylvania's Solar Future"* on February 16th. The webinar was the first in a series of working group meetings and events lead by the Pennsylvania Department of Environmental Protection to develop a solar energy plan for the state. The PADEP received a \$550,000 grant from DOE/EERE's Sunshot Program to work with key stakeholders to design and develop a plan that would result in at least 10 percent of Pennsylvania's electricity generated from solar by 2030. NETL is participating in the working group to ensure that the PADEP is aware of efforts under the MOU to include solar energy in the "network of microgrids" to be built in Pittsburgh.
- On February 24th, the Federal Laboratory Consortium posed a story on the MOU entitled *"NETL Helping Create Pittsburgh's Energy Future Today"* that highlights how the DOE's national laboratory system successfully works with local and regional partners on technology development and innovation. The story can be viewed at <https://www.federallabs.org/index.php?tray=content&tid=1FLtop221&cid=166DWlaptop147>
- On March 2nd NETL participated in a *"Finding Pennsylvania's Solar Future"* project working group meeting in Harrisburg. Over a hundred people attended the event with expertise in business, state and local government, the solar energy market, utilities, regional transmission, regulation, academia, environmental advocacy, and consumer advocacy. Opening remarks were given by Dr. Elaine Ulrich from the U.S. Department of Energy SunShot Initiative and DEP Acting Secretary Patrick McDonnell. The main goal of

this first meeting was to provide an introduction to the project, answer questions, and help interested stakeholders learn how they can best contribute. The next meeting will be in the Pittsburgh area on June 8th.

- At March 2nd meeting in Harrisburg, met and discussed Pennsylvania policy and regulatory developments encouraging distributed energy development with Mark Haas, PECO's Director of State Government Affairs.
- NETL met with Dr. Elaine Ulrich, Director of DOE/EERE's Balance of Systems Program at the March 2nd solar working group event in Harrisburg. As a follow up, Mr. Feeley provided Dr. Ulrich a copy of the MOU and an article about the work being done with the City of Pittsburgh.
- A briefing by Duquesne Light's executive management team was given on March 5th at DLC's Woods Run facility to participants in DOE's Energy Sciences Leadership Group/Oppenheimer Science and Energy Leaders Program. DLC's President and CEO Rich Riazzi, Vice President of Operations Mike Doran, and Strategic Planning and Operational Analytics Senior Manager Ben Morris spoke to a group from DOE's national laboratory system about the changing electrical grid and DLC's participation in the MOU between NETL and the City of Pittsburgh.
- NETL participated in a March 7th NRG Energy groundbreaking ceremony for NRG's Uptown Energy Project. This project will provide steam, chilled water and backup power for UPMC Mercy Hospital with plans to extend to other buildings and facilities located in and around the Lower Hill district. NETL is identified as one of NRG Energy's community/industry partners on the project. NETL, through a cooperative agreement with Fuel Cell Energy, is also working with NRG to potentially install and test a 200kW to 400kW Solid Oxide Fuel Cell at NRG's North Shore Energy Center starting in late 2017 or early 2018.
- NETL participated in a webinar on March 23rd on changing regulations and policies affecting distributed energy and microgrids in California and New York.



Cliff Blashford, V.P. and General Manager of NRG Energy Center Pittsburgh provides welcoming remarks at Uptown Energy District groundbreaking

4.0 Funding Opportunity Announcements

A key goal (Goal 2) of the MOU is to identify financial opportunities to help catalyze investment in the City’s “network of microgrid” concept. The table below lists a number of Financial Opportunity Announcements (FOA), Notice of Intent (NOI), and other federal funding announcements that have been identified and shared by NETL with the MOU partners that could potentially provide financial support for the MOU.

Opportunity/Description (Issuing Office)	Award Info	Status/Notes
DOE/EERE Strategic Program Cities Leading through Energy Analysis and Planning (Cities-LEAP) FOA		City of Pittsburgh with NETL as a partner submitted concept paper that was not selected for funding.
DOE/EERE Vehicle Technologies Office Fiscal Year 2016 Vehicle Technologies Multi-Topic Funding Opportunity Announcement	Approx. \$22.3 million of DOE funds. Awards expected to range from \$2 million to \$5 million.	City of Pittsburgh was a partner on the Kansas City application and is awaiting notification from DOE/EERE.
DOT Smart Cities Challenge NOFO to demonstrate and evaluate a holistic, integrated approach to improving surface transportation performance within a city and integrating this approach with other smart city domains such as public safety, public services, and energy.	\$40 million from DOT with additional \$10 million to be provided by Vulcan Inc. The City of Pittsburgh were one of seven cities selected to submit an application against the NOFO.	NETL was a partner in a City of Pittsburgh application submitted to DOT 5/24/2016. However, Columbus, Ohio was selected.
DOE/EERE Solar Energy Technologies Office Community Solar Challenge Notice of Intent	Prizes totaling \$1.5 million expected, in allocations of \$50,000 or \$20,000 to teams.	NETL provided NOI information to MOU team.
DOE Office of Electricity Delivery and Energy Reliability Sensor and Modeling Approaches for Enhanced Observability and Controllability of Power Systems with Distributed Energy Resources (DERs) FOA	Approx. \$7 million of DOE funds; Awards expected to range from \$250,000 to \$1.5 million. Cost share: 20% for R&D; 50% for demo.	NETL provided FOA info to MOU team, however no application was submitted.
DOE/EERE/Geothermal Technologies Office Scaling Up the Next Generation of Building Efficiency Packages FOA	\$6.5 million of DOE funding. Awards expected to range from \$200,000 to \$700,000. Approx. 15 awards anticipated.	NETL provided FOA info to MOU team and Consortium for Building Energy Innovation, however, no application was submitted.
DOT Fixing America’s Surface Transportation Act	Funding provided under DOT’s “Fixing America’s Surface Transportation Act”	On 10/11/2016 DOT announced that the City of Pittsburgh would receive a \$10.9 million grant for “smart spines” that use information gathered from a network of sensors to balance traffic and move it through areas more quickly. The City of Pittsburgh was selected in large part to favorable review of their application

		submitted against DOT's Smart Cities Challenge NOFO.
DOE/EERE Geothermal Technologies Office Geothermal Deep Direct-Use Feasibility Studies NOI		Provided NOI information to NETL's deep direct geothermal team.
National Science Foundation Smart and Connected Communities	\$18.5 million of NSF funding. NSF anticipates 8-14 awards.	NETL's Kelly Rose collaborated with City of Pittsburgh and Carnegie Mellon University to submit a pre-proposal by the 11/30/2016 deadline.
DOE/EERE/Geothermal Technologies Office Geothermal Deep Direct-Use Feasibility Studies Funding Opportunity Announcement FOA	\$4.0 million of DOE funding; EERE anticipates ~ 5-16 new awards; Individual awards in Topic Area 1 may vary between \$240,000 and \$900,000; Awards in Topic Area 2 will be for up to \$350,000.	NETL Deep Direct Geothermal team submitted a concept paper for Camp Dawson, WV by the 12/15/2016 deadline. Full application will be submitted by 2/22/2017.
DOE/EERE/Solar Energy Technologies Office SunShot Initiative Solar in Your Community Challenge to expand solar energy access to underserved segments, specifically low- and moderate-income (LMI) communities.	Prizes totaling \$5.0 million expected. A \$500,000 Grand Prize will be awarded to the team that can most successfully demonstrate a scalable model to bring solar to LMI markets. Teams will also compete for an additional \$500,000 in Final Prizes.	NETL conveyed telecon on Dec. 19 th with interested partners to discuss announcement. ACTION-Housing will take lead in submitting an application due for a community-based solar project in Homewood. Applications are due in mid-March 2017.
DOE/EERE Vehicle Technologies Office Vehicle Technologies 2017 Deployment FOA (contains two Areas of Interest -- one seeking highly-leveraged, community-based AFV deployment projects, and another for "living lab" deployments of energy efficient "smart" mobility systems)	\$15.59 million of DOE funding expected; DOE/EERE anticipates making awards that range from \$1,000,000 to \$5,000,000.	NETL shared the FOA with the Pittsburgh Region Clean Cities Program and the City of Pittsburgh. The FOA specifically encourages teaming arrangements that include one or more designated Clean Cities Coalitions or U.S. Department of Transportation Smart Cities Challenge applicants.
DOE's Office of Energy Policy and Systems Analysis Regional Energy Technology Innovation Ecosystem Characterization Assessments to fund analytic studies that assess the possibilities and challenges associated with developing a multi-state region's energy innovation ecosystem to meet the energy needs and opportunities of that region.	\$800,000 of DOE funding expected; DOE anticipates making four awards of up to \$200,000 each. Awards will have estimated project periods of ~ six months.	NETL working to determine interest in submitting an application with NETL as a partner. Proposal team must be led by a non-profit; educational institution; or a State/Local/Tribal government from the proposed region.

DOA Bioenergy Technology Office Integrated Biorefinery Optimization FOA to identify, evaluate, and select applications to address challenges with the scale-up and reliable continuous operation of Integrated Biorefineries for the manufacture of Advanced or Cellulosic Biofuels and associated higher value bioproducts.	\$19.8 million of DOE funding expected, and \$2.9 million of USDA funding expected; DOE/EERE anticipates making ~ five awards, ranging between \$1,000,000 and \$10,000,000.	FOA shared with NETL's Dr. Madhava Syamlal and Dr. Bill Rogers.
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5.0 Products/Deliverables this Quarter

- Pittsburgh Energy & Emissions Baseline Report
- The City of Pittsburgh MOU webpage: <https://www.netl.doe.gov/research/energy-efficiency/pittsburgh-mou>
- FLC Success Story on the City of Pittsburgh MOU: <https://www.federalallabs.org/index.php?tray=content&tid=1FLtop221&cid=166DWlap147>

6.0 Planned Activities for Next Quarter

- Brief Pittsburgh Sports & Exhibition Authority on MOU and discuss SEA's parking garage solar project
- Set up follow-on meeting with Mark Haas, PECO's Director of State Government Affairs to discuss development's in Pennsylvania policy and regulations encouraging distributed energy
- Present baseline energy and emissions analysis at Allegheny League of Municipalities at Seven Springs event on April 8th
- Brief Allegheny Conference on status of MOU